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Modeling of auctions for the wholesale electricity market

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General context of the electricity sector reform

Nowadays Russian energetics experiences a crucial stage of its development: the property structure and mechanisms of interaction between participants of this economic sector are being formed. Proposed by RAO UES and approved by government resolutions, the program of industry reform suggests creation of independent energetic companies and development of the competitive market. According to these documents the main reasons for the reform start are as follows.

1. Prices formed on the cost method did not stimulate cost reduction and production efficiency increase. Under central planning system, it was profitable for agents to report false information on production costs. Contract relations on the wholesale market based on attachments of counteragents by the contract payment center turned out to be inefficient.
2. The industry needs huge capital investments for restoration and modernization of the production capacities and infrastructure. State investments are rather inefficient. Thus, it is necessary to privatize an essential part of generating capacities and provide an investment attractiveness of the enterprises.

The main argument for preservation of the state price regulation is an expectation of the significant price growth after transition to the deregulated market. Under conditions of Russian economy, such growth may lead to the mass bankruptcies in a number of industries where a large part of population is occupied. Therefore a question of the price level after the reform turns out to be very important for the choice of its concrete variant.

First-price auction and possible electricity price growth

One of the basic elements of the deregulated electricity market is a day before auction for wholesale electricity prices determination. Now it is organizes as a "first-price auction" where the ultimate price equalizes the total supply and the total demand computed from participants' bids. Price forecasts by RAO UES (as well as by several theoretical papers) consider the competitive equilibrium price as the expected outcome of such auction. One of our main conclusions is that this kind of an auction provides a possibility for large generating companies to execute their market power. The market price in such auction may substantially exceed the competitive equilibrium price due to imperfect competition. Under rational behavior of generating companies aiming to maximize their profits, the excess is proportional to the share of the largest company in the market and inversely proportional to the demand elasticity. A low demand elasticity and rather high concentration are typical for electricity markets. Our estimate shows that under the current project of the market design the price may 4-5 times exceed the competitive price. Computation of the expected price for the data on the Central Economic Region of Russia in 2000 confirms this estimate. Note that in that year the wholesale price exceeded the competitive price less than two times.

Nowadays we do not observe any fast growth of the price because the share of the deregulated market and the price there is limited by the price in the regulated market (FOREM). Moreover, the theoretical studies show that behavior of generating companies in the completely deregulated market may essentially differ at the stage of the market development and at the further stage when a stable structure of its participants is formed. The economic theory shows that at the first stage, under conditions of the sharp intrasector competition, the optimal strategy for a firm's growth and survival is competitive behavior. It means increasing of the production volume until the marginal cost is equal to the market price. Meanwhile, for the second stage the optimal strategy is a maximization of the profit. Therefore and also because of political reasons we may expect that a significant growth of the price related to transition from the competitive equilibrium to the oligopolistic (by Cournot) equilibrium

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of the first-price auction will take place after formation of the basic staff of the market participants.

There exist two possibilities to prevent the price growth: 1) to hold the government regulation; 2) to employ an alternative market mechanism. Shortcomings of the first way are well known: it creates a possibility for abuse of administrative power, corruption and reduction of the market efficiency. So in our research we focus on analysis of different variants of the day before auction organization.

Vickrey auction and policy proposals

A reasonable alternative to the standard auction is Vickrey auction with reserve prices. In such auction the payment to each company proceeds from reserve prices that are calculated on the base of the demand function and the bids of other firms. Our report describes a mechanism of this auction and a method for its outcome calculation for a local market and a simple network market with two nodes. The advantage of this auction is maximization of the total welfare of participants (producers and consumers) under individually rational behavior (corresponding to the Nash equilibrium in dominant strategies). Our computations for the data on the market in the Central economic region of Russia show that under typical values of electricity demand elasticity, the expected price for consumers in such auction would be essentially (2-3 times) lower than the price in the standard first-price auction. An additional decrease of the price for consumers may be obtained if computation of the reserve prices takes into account information on marginal costs and maximal capacities of generators. Our report provides the corresponding method.

Proceeding from the mentioned results, we conclude that RAO UES and state departments concerned with energetics should organize the work on technical, organizational and legislative issues of Vickrey auction implementation as an alternative to the standard first-price auction.